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ABSTRACT

Fifty-eight kindergarten children were assessed on traditional presentations involving the conservation of number and liquid. Each conservation test contained two different items and began with the stimuli quantitatively and perceptually equal. Two other conservation tasks for number and liquid with initial nonequivalence followed. Performance on tasks with initial equivalence and tasks with initial nonequivalence were not closely related. Children's strategies for solving tasks with initial nonequivalence frequently involved consideration of auxiliary problems and were not the most parsimonious in obtaining an answer. Results suggest that whether children can access appropriate schemata for making conservation judgments is influenced by variations in the tasks and that the schemata used in considering tasks with initial equivalence or nonequivalence may themselves vary. (Author/RH)

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Performance on Two Conservation Problems with Initial Nonequivalence

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RUNNING HEAD: Nonequivalence

Performance on Two Conservation Problems with Initial Nonequivalence

ABSTRACT

Kindergarten children were assessed on traditional presentations of number and liquid, each test begun with the stimuli quantitatively and perceptually equal. Two other conservation tasks for number and liquid with initial nonequivalence followed. Performance on tasks with initial equivalence and tasks with initial nonequivalence was not closely related. Children's strategies for solving tasks with initial nonequivalence frequently involved consideration of auxiliary problems and were not the most parsimonious in obtaining an answer. Results suggest that whether children can access appropriate schemata for making conservation judgments is influenced by variations in the tasks and that the schemata used in considering tasks with initial equivalence or nonequivalence may themselves vary.

Performance on Two Conservation Problems with Initial Nonequivalence

When children fail to conserve on traditional presentations of conservation tasks, one does not know whether the first condition toward finding a solution has been met, that is, that the child understands what the problem is (Polya, 1957). The presence of materials other than those essential to the solution may enable the child to consider auxiliary problems if an immediate connection between the question and the stimuli already before the child cannot be made. This heuristic approach, combined with the child's ability to keep the problem in mind, may make possible a solution that demonstrates conservation where a more standard presentation would not.

The data I'm reporting today are interesting in that we assessed children on conservation of liquid and number using traditional presentations with initial equivalence of the materials and other nontraditional conservation problems for number and liquid without initial equivalence. Our findings show no relation between conserving responses on traditional and nontraditional conservation problems for number and a modest relation for conservation of liquid. Two important possibilities are raised by these data: first, that whether children can access appropriate schemata for making conservation judgments is influenced by variations in the tasks and second, that the schemata used in considering tasks with initial equivalence or nonequivalence may themselves vary. This is

particularly striking in the data on conservation of number where no relationship existed between performance on the two types of presentation. One possibility is that this constitutes evidence not just of a performance/competence distinction according to variations in the task, but that it also suggests that the operatory structures of novice and expert conservers may actually differ (cf. Resnick and Gelman, 1984; Larkin, McDermott, Simon, and Simon, 1980).

A number of studies have shown that a different method of presenting conservation problems does indeed produce different results. Smedslund (1963) investigated the relative value of a fixed versus a free procedure in the acquisition of transitivity of weight and found that children under 7 years old did benefit from a free procedure while older children did not. There were some individual cases where tasks with a free procedure proved harder than those with a fixed procedure.

In an investigation of conservation of substance, weight and volume, Uzgiris (1964) found that the percentage of subjects offering conserving responses for any given quantity varied across the different materials used. McGarrigle and Donaldson (1974/75) found that traditional procedures for assessing conservation abilities yielded quite different and considerably fewer successful explanations than did responses to transformations of quantity which occurred "accidentally." Results from anticipation-of-conservation tasks (Acredolo and Acredolo, 1979, 1980) also show discrepancies from traditional methods

of presentation.

Frank (in Bruner, Olver, and Greenfield, 1966) argued that preconserving children might be subject to "perceptual seduction" which caused them to judge the amount of liquid in the classical conservation of liquid task in terms of a single, salient property of the display. Miller and Heldmeyer (1975) argued that conservation of liquid was better represented as an ability consisting of several levels. Even children who are classified as conservers on classical tasks may demonstrate that their concepts of conservation are not always stable. Kingsley and Hall (1967), for example, showed that "natural conservers" may fail to provide conserving responses on weight when quantities are inconspicuously altered.

Gelman (1969) suggests that there are skills which exist apart from conservation, the development of which lead the child to eventual understanding of conservation. Attention to irrelevant stimulus changes, rather than the absence of appropriate schemata (Piaget, 1952), may prevent the child from offering conserving responses.

Peters' (1967) review of a number of studied of induced conservation points out that an important aspect of conservation is attentiveness to the appropriate cues, the salience of cues being dependent on the materials used in the tasks and in the manner of presentation. Task variations that increase the salience of the appropriate cues lead to improved conservation performance.

The study reported here attempted to compare performance on 1) traditional tasks of conservation of number and liquid with their initial equivalence to 2) performance on nontraditional tasks of conservation of number and liquid where initial equivalence did not occur as part of the procedure. The attempt here was to allow the child more freedom to define the task and to engage in pursuing auxiliary tasks or strategies that the child determined were relevant to the solution. The study predicted that there would not be a simple relation between children's performance on traditional conservation tasks and task variants. In addition, children's strategies for obtaining an answer on the tasks with nonequivalence would not necessarily be those older children and adults would find most parsimonious in obtaining an answer.

Subjects and Procedure

Fifty-eight kindergarten children were assessed with traditional presentations of conservation of number and liquid. Each conservation test contained two different items and began with the stimuli presented so that they were quantitatively and perceptually equal. After each child accepted the initial equivalence of the two quantities, the quantity was transformed. Each child's judgment of "same" or "different" was followed by the child's justification for that answer.

Following these traditional conservation tasks, two other conservation tasks for number and liquid were presented. These

tasks consisted of two problems with extra materials available to the child, and with no set behaviors on the part of the experimenter once a problem had been introduced. Varying the conservation tasks presented an opportunity for manipulations on the part of the child in a self-structured context.

The conservation of number problem consisted of two transparent plastic boxes, each with eight items in it. One box had eight checkers, the other eight plastic pieces varying in size, shape and color. The experimenter announced the task by saying,

> "Here are two boxes of plastic things. I want you to find out for me which box has more in it, or are they the same. You can take the pieces out of the boxes if that will help you to figure out the answer."

Insert Figure 1 about here

The experimenter then recorded exactly what the child did and any verbalizations that occurred.

For the conservation of liquid problem, the experimenter held a cardboard screen in front of a plastic champagne glass and an opaque paper cup while she poured 3 ounces of colored water in each. She then removed the screen. In addition to the two containers of liquid, a measuring cup, an extra opaque cup of the same size as that already used, and two identical

plastic cups were nearby. The experimenter then recorded what the child did and said.

Insert Figure 2 about here

Results

Scoring for conservation followed Gelman's (1969) criteria. On the traditional and nontraditional tasks of conservation of number, performance was not closely associated. Thirty-one of the 58 children gave nonconserving responses on the traditional tasks, i.e., gave no response for either one that included a "same" judgment and an adequate justification. Of these nonconservers, 12 (39%) were able to determine that on the task with initial nonequivalence the two quantities were the same. These determinations were in most cases based on one-to-one correspondence or counting. Of the 27 children who were classified as partial or full conservers on number, only 16 determined that the box of checkers and the box of plastic pieces had the same number.

Chi-square calcuations show no significant relationship between performance on traditional and nontraditional tasks for conservation of number ($\chi^2 = 2.44, p > .05$). It appears that judgments of equivalence are independent on these differing presentations of the tasks.

Insert Table 1 about here

All of the six children who were assessed as conservers on the traditional conservation of liquid tasks were able to conserve when there was initial nonequivalence. Of the 52 children assessed as nonconservers on traditional tasks for liquid, 11 were able to determine that quantities were the same on the nontraditional task and to provide sufficient verbal justification to classify them as conservers on this task. In addition, nine children said the two quantities were the same though they could not adequately articulate their reasons.

Insert Tables 2 and 3 about here

A further "test" of the relationship between traditional and nontraditional presentation of these tasks is provided by considering the children's performance on the traditional conservation of number task and the nontraditional liquid task. This comparison allows us to see whether children who have a schema for at least one level of conservation as traditionally assessed are more likely to show conserving responses on the nontraditional task. Table 3 demonstrates a moderate degree of association.

Discussion

Results suggest that whether children can access the appropriate schemata they possess for making conservation judgments is influenced by variations in the tasks. Tasks that permit the child to demonstrate understanding of dynamic

transformations of quantity do not necessarily involve simplifying the tasks. Rather, allowing the child to consider other problems, exercise more control in defining the problem and in seeking an answer demonstrates once again the importance of researchers continuing to investigate the child's construction of quantity.

One direction of inquiry suggested by these data is whether the schemata accessed in evaluating quantities with initial nonequivalence are the same as schemata accessed in evaluating quantities with initial equivalence. Because there is no relationship between performance on the two types of tasks in evaluating number, I would suggest that different schemata may be employed in considering problems of number with initial equivalence and initial nonequivalence. This seems likely in light of work on novice and expert problem solving that shows different operations are used by novices and experts (Larkin, McDermott, Simon, and Simon, 1980). Kindergarten children, many of whom do not demonstrate conservation on traditional conservation of number tasks, are certainly novices with regard to conserving quantity. After all, conservation of number is the first area in which children demonstrate conservation.

Children who are making judgments of conservation on liquid tasks may be said to be something other than novices since they already demonstrate conservation on number and length. It should not be surprising then to find that all of the children

who conserved liquid when the task began with initial equivalence also conserved when the task began with initial nonequivalence. A more interesting area of inquiry would be exploring further the means by which 11 other children who were nonconservers on the traditional presentation of the conservation of liquid tasks determined that the liquids were equivalent in the nontraditional task.

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Table 1

Number Task

		Traditional (Initial Equivalence)	
		Nonconservers	Conservers
Nontraditional (Initial Nonequivalence)	Nonconservers	19	11
	Conservers	12	16

$n = 58$

$\chi^2 = 2.44,\ p > .05$

$\phi = .21$

Table 2

Liquid Task

		Traditional (Initial Equivalence)	
		Nonconservers	Conservers
Nontraditional (Initial Nonequivalence)	Nonconservers	41	0
	Conservers	11	6

$n = 58$

$\chi^2 = 16.14,\ p < .001$

$\phi = .53$

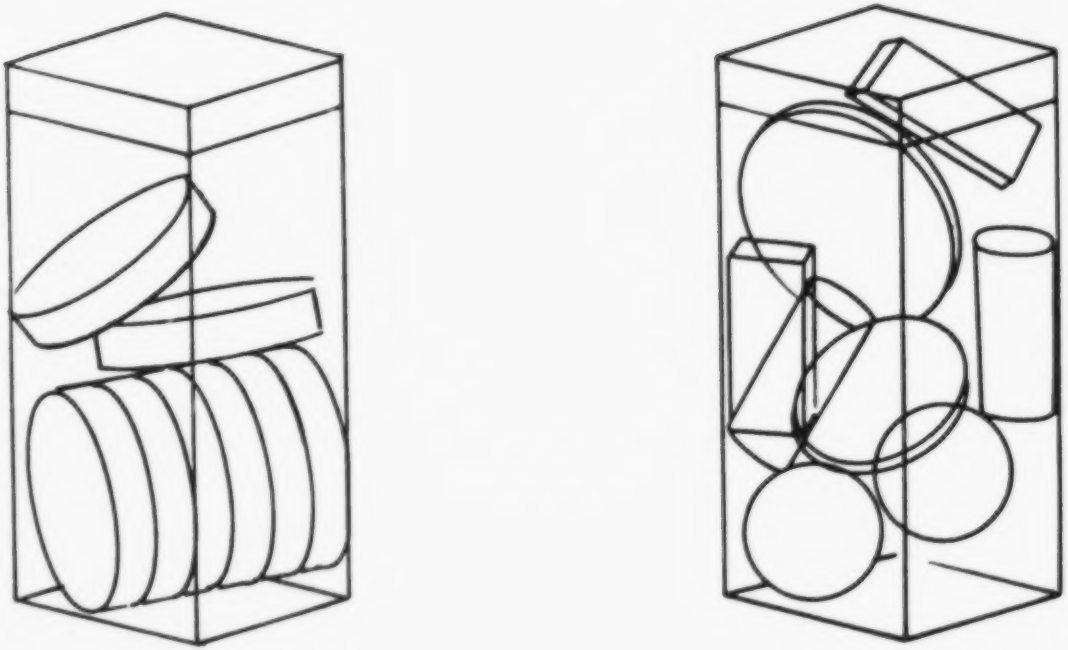
Table 3

		Nontraditional Liquid Task	
		Nonconservers	Conservers
Traditional Conservation of Number	Nonconservers	30	1
	Conservers	15	12

$n = 58$

$\chi^2 = 14.10,\ p < .001$

$\phi = .49$



Number Task

FIGURE 1

Liquid Task

FIGURE 2